DEVELOPMENT OF PROCESS FRAMEWORK TO MIGRATE LEGACY APPLICATION TO CLOUD ACROSS LAYERS

A
Synopsis

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1 Introduction

1.1 Industry Dilemma

Technology is evolving is at a very fast pace so is the business needs are getting change because of ever evolving customer demand and business competition. Multiple approaches may be available at the disposal of any organization to beat the competition and meet customer demand. IT can be one of the approaches available with organization to deliver the required services to its customer.

Big question is; what should an organization do with the existing legacy applications, which they may not be able to discard because these applications are business critical and heavy investment has gone into to build these business critical applications over a period of time for the business's smooth operation.

Migration of legacy application can be a way to achieve organization's designed goal/target. If due to any reason, an enterprise choose not embrace the new prevalent technology then enterprise may face the multiple challenges such as shortage of skilled manpower, high cost of software maintenance, lack of scalability, business continuity, along with customers experience, enterprise image[12], etc., which will not be in the interest of enterprise.

If an enterprise chooses to embrace the new technology such as cloud, which deliver hardware and software resource as virtualize service[6] than enterprise has three options with respect to their current application in the interest of the enterprise long term goal:

a) Migrate existing application
b) Replace existing application with any off-the-shelf application
c) Re-develop the existing application

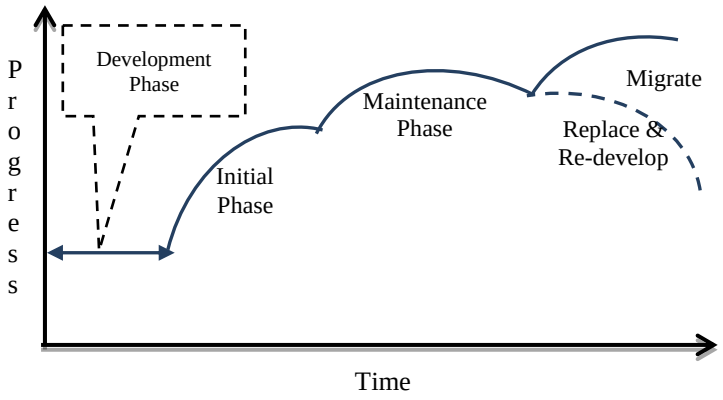

Figure 1 - Legacy Application Modernisation Options

Option (b) i.e. *replace* or option (c) i.e. *re-develop* option may not be feasible as organization may not like to put in all the effort, time and cost all over again, when they already have an existing application running, so the only feasible option available with enterprise is to migrate the current application to new technology that in our case is Cloud.

An enterprise may understand the importance of migrating legacy application to Cloud technology; however the challenge an enterprise faces is an uncertainty of where to begin the legacy application migration process and what need to be done during the migration process. Biggest of all question is will the migration be successful.

Below sections gives an overview about what is Cloud and what are Legacy Applications.

1.2 Cloud – An Overview

Cloud computing is a computing paradigm and a buzz word which is of interest of academic, practitioners and enterprise equally. As of now, everyone has their own way to define cloud so conclusive definition is not there for cloud however definition given by National Institute of Standards and Technology, USA is the most referred definition.

National Institute of Standards and Technology, USA (NIST) define cloud computing as "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction".[10]

Gartner defines cloud computing as a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies[11].

Forrester defines cloud computing as, "A pool of abstracted, highly scalable, and managed compute infrastructure capable of hosting end-customer applications and billed by consumption."

Major advantage of moving to cloud is that the resources are made available without up-front investment and resources can be utilized based pay as you use model.

According to NIST, Cloud model consist of five essential characteristics, three service models and four deployment models [10], which is explain as follows.

1.2.1 Essential Characteristic

According to NIST definition, characteristics are defined as follows:

- On Demand Self Service
- Broad Network Access
- Resource Pooling
- Rapid elasticity
- Measured service

Source: Based on "The NIST Definition of Cloud Computing", Special Publication 800-145, NIST, US

1.2.2 Cloud Delivery/Deployment Model

Cloud commuting is also divided into four deployment/delivery models as per NIST. Each of these delivery models has its own advantages and application as required my customer. Four major cloud delivery models are:

a) **Public cloud:** As the name suggests, this type of cloud deployment model supports all users who want to make use of a computing resource, on a subscription basis. e.g., Google, Amazon, and Salesforce are a few notable examples

b) **Private cloud:** As the name suggests, a private cloud is typically infrastructure build and used by a single organization. Such infrastructure may be

managed by the organization itself to support various user groups, or it could be managed by a service provider that takes care of it either on-site or on premise (internally) or off-site (externally).

i. On-site Private Cloud: On-premise cloud is hosted within enterprise's own data center.

ii. Off-site Private Cloud: Off-site cloud is hosted externally with a cloud provider, which facilitate an exclusive environment for the enterprise.

c) **Hybrid cloud:** As the name suggest, Hybrid cloud is the amalgamation of Private and Public cloud, so in a hybrid cloud, an enterprise makes use best of both the world i.e. Public cloud and Private cloud by having part of the application remain on-premise and part on cloud.

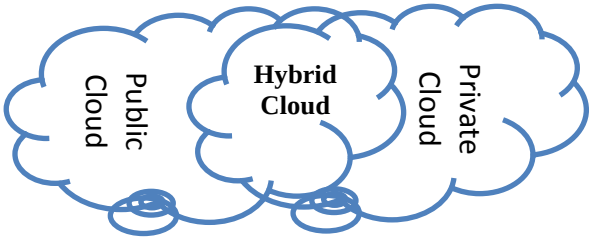

Figure 2 - Hybrid Cloud

d) **Community Cloud:** Unlike type of cloud defined above, community cloud is there for exclusive use of a particular community that has shared concerned or common purpose.

1.2.3 Cloud Service/Model Type

The three service type defined by NIST are SaaS, PaaS and IaaS., focus on the specific layer- the hardware, the system software (platform) and the application respectively. Cloud three service models are described as follows:

a) **Software as a Service (SaaS):** Any applications delivered as a service to end users (consumer) over the Internet via cloud infrastructure, for which user pay for its usage. Example of SaaS providers are Salesforce.com, Abiquo, Akamai, Cloud9 Analytics, CloudSwitch,CloudTran , SAP etc.

b) **Platform as a Service (PaaS):** Application development and deployment platform (comprising application servers, databases, etc.) delivered as a service. Example of PaaS providers are Amazon Web Services, Appistry, AppScale, CA Technologies, Force.com (Salesforce.com's Platform-as-a-Service arm), gCloud3, Google, Microsoft, etc.

c) **Infrastructure as a Service (IaaS):** Server, storage, and network hardware and associated software delivered as a service over the network. Example of IaaS providers are Amazon Web Services, AT&T, CA Technologies, BlueLock, Cloudscaling, ENKI, etc.

Company names provided above are in random order and sequencing does not hold any meaning.

1.3 Legacy Application – An Overview

Let us try to understand, what is legacy system is? It is also known as "**legacy system**" or **legacy application"**[16] and **"legacy software".**

How dictionary define "legacy". As per Merriam-Webster, **legacy** means "something that happened in the past or that comes from someone in the past"[15].

As per BusinessDictionary.com; **legacy system** is defined as "Obsolete computer system that may still be in use because its data cannot be changed to newer or standard formats, or its application programs cannot be upgraded" and **legacy application** is defined as "Computer program (typically a database system) which, although critical to an organization's operations, is in an obsolete format or is installed on an obsolete system.

2 Literature Review

Researchers and enterprises are putting effort in developing migration framework but they are trying to address a particular area of migration in bits and pieces as per there requirement however none has provided holistic legacy application migration framework to cloud end-to-end. Same was highlighted by Pooyan Jamshidi, Aakash Ahmad, and Claus Pahl in there systematic literature review (SLR) on legacy software to cloud migration. Review paper published by Pooyan Jamshidi, Aakash Ahmad, and Claus Pahl is one of its kind papers which, took into consideration 23 research paper ranging from 2010 to 2013. Author's review reveals that there is a need for a migration framework, which is non-existence as off now. Paper also reveals that due to lack of frameworks, people do not have trust in application migration to cloud.

Following are the tabular form, arrange in (year-wise) descending order, of all the research work consider as part of literature review:

Research Paper Title	Paper Type / Year	Area in Cloud Service Model			Remarks
		SaaS	PaaS	IaaS	
Migration Management in Cloud Computing[21]	Research / 2014	×	×	×	Author has shared multiple way to migration patterns and has given a detail workflow which can be utilized for the migration of application to cloud however lack a framework across layers.
Cloud Computing: Migration from Traditional Systems to the Cloud[2]	Research / 2013	×	×	×	Paper does not present any migration framework but have shared the considerations that should be taken into account.
Cloud Migration Research: A systematic Review[3]	Review / 2013	×	×	×	Author review reveals that there is a need for a migration framework, which is non-existence as off now.
A Cost-effective Approach for Hybrid Migration to the Cloud[6]	Research/ 2013	√	×	×	Author proposes a decision making process based on a set of measurable factors in pricing models of cloud providers. Then proposed cost measuring function is used to choose the optimal migration scenarios.
Cloud Computing A Research Roadmap in Coalescence with Software Engineering [9]	Research/ 2013	×	×	×	Author has highlighted that there is a lack of focus on research and development in this area of software engineering and suggest that rethinking is required to exploit the software engineering principles behind Grid, SOA and Web technologies for a better realisation of services in cloud systems.
Challenges for	Research/	×	×	×	Author highlight that software

Research Paper Title	Paper Type / Year	Area in Cloud Service Model			Remarks
		SaaS	PaaS	IaaS	
Migrating to the Service Cloud Paradigm: An Agile Perspective[5]	2012				migration to cloud provides strategic and operational advantage but at the same time author has also highlights that there is a lack of mature process.
A five-phased approach for cloud migration [13]	Research / 2012	√	×	×	Author has proposed a five-phased waterfall model for migration to cloud but have not dwelled into the details of how.
Towards Process Support for Migrating Applications to Cloud Computing [14]	Research/ 2011	×	×	×	Author of view that this not enough attention is given to as such migration process
A Comparison of On-premise to Cloud Migration Approaches - A Tale of Four Cloud Migration Processes [18]	Research/ 2012	N/A	N/A	N/A	Author is trying come-up with layer specific process and discusses the commonalities.
Legacy Application Migration to Cloud [19]	Research/ 2011	N/A	N/A	N/A	Author proposes an application migration solution to migrate legacy application efficiently with the help of GUI recognition and reconstruction technology.
Migrating Legacy Applications to the Service Cloud[22]	Research / 2009	√	√	×	Author presents a generic methodology which shows how to migrate legacy applications to the service cloud computing platform.

Table-1: Focus area of earlier Research in tabular format

3 Justification/Importance of Study

Literature review and analysis shows that good amount of research work has gone into proposing methods of migrating application to cloud however they it seems that all these methods are specific to a particular area/layer. At the same time many of the researchers have highlighted the importance of migration process and lack of the same, so need of the hour is to have a holistic end-to-end legacy application migration framework.

Fact which needs to be highlighted is that the Legacy application concepts makes migration a challenging task i.e. it not a straight forward task as it seems to be[13], especially when migrating a legacy application, which is tightly coupled[17] as compare to cloud application requirement. Cloud computing technology offers several benefits to users, which need no elaboration. One of the biggest benefits cloud technology provides is that organization can focus on the business challenges instead of struggling with IT requirement to meet the business need i.e. license cost, server cost, storage space, etc.

4 Research Objective and Problems

If an enterprises does not carefully plan, execute and monitor the legacy transformation using established processes[7] then organization may not get the desired result and all effort and money will go waste and keeping many of the facts

highlighted in sections a above specially under the section "Literature Review" i.e. a) amount of benefit cloud computing provide to enterprise, b) challenge of migrating application to cloud and c) non-availability of any end-to-end migration framework.

I feel motivated to work upon to come-up with, a flexible[1] end-to-end legacy application migration framework, which addresses:

a) Area of Pre-migration, Migration and Post-migration.
b) Area of Governance, cutting across layers of migration area

Last but not the lease that framework should also help enterprises to do their migration in more structured manner as it is important to execute the migration process in structured and planned manner because, if an enterprise do not carefully plan, execute and monitor the transformation using established processes[7] then organization may not get the desired result and all migration effort and money may go waste and at the end instead of getting benefited by migration enterprise will be detriment.

5 Methodology

In the proposed work, the research emphasis on the:

- Literature Survey: In depth analysis of existing work and their results.
- Implementation: Framework will be implemented in three companies minimum, which provides migration services in phased manner.

For analyzing the effectiveness of the framework; it will implemented in three selected companies providing migration services to their client. Data collected will be analyzed to understand the effectiveness and result will be presented.

6 Place of work and Facilities Available

The following facilities will be used:

- IEEE's library
- Online Library
- Implementation in company providing migration services

7 Summary

As it is a known fact that developing an enterprise level application is a mammoth task, which involves the enormous cost, time and effort and no enterprise will want to forgo the investment made in the application, which is core to its business. If enterprise plans to embark on migration journey than enterprise needs a well defined flexible customizable migration process framework. Lack of the same will lead to effort and money wastage.

Proposed flexible customizable framework will:

[1] In this context flexible framework means that framework should be flexible enough to accommodate or can be customized as per the migration project requirement.

a) Provides a systematic approach and roadmap for the legacy application migration to cloud. It will cover all Cloud Service i.e. SaaS, PaaS and IaaS and all migration aspects. Framework follow Four Area approach, these areas are a) Pre-migration Area, b) Migration Area c) Post-migration Area and d) Governance Area. These areas will be further sub-divided into Activities. Framework will help enterprise to migrate to Cloud in an easy and efficient manner with a clear goal to achieve in each migration area and phase.
b) Address the concern about large up-front investment and expensive infrastructure as post migration enterprise need to "pay-as-you-use" basics, basic of cloud trait. i.e. enterprise will be able to save the heavy investment made by re-using the existing code, platform or infrastructure.

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